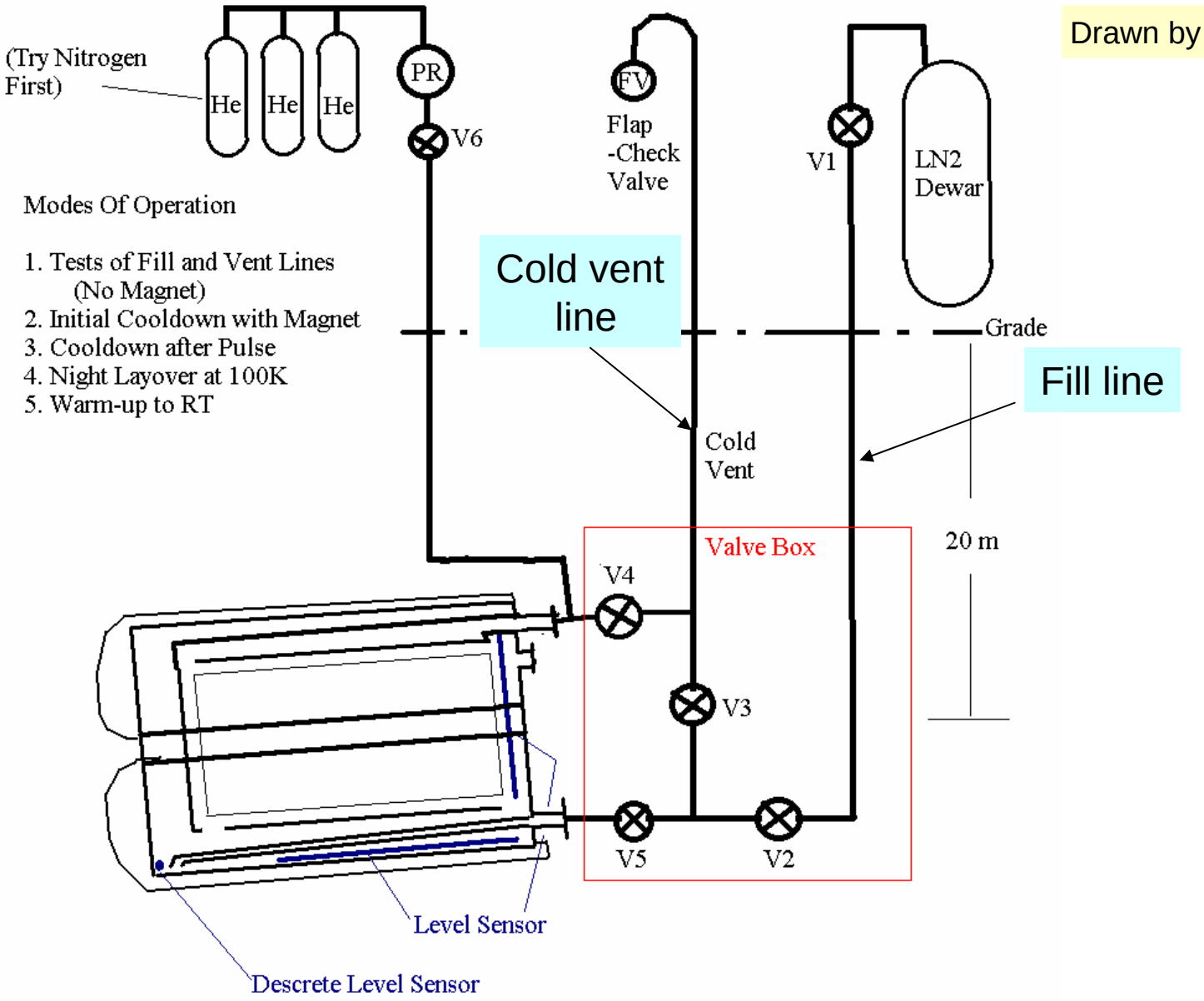
CERN P186
Magnet cryogenic system update

Yury Ivanyushenkov
RAL

December 7, 2004

Liquid nitrogen cooling system: Diagram



Drawn by Peter Titus

Flexible transfer lines available at CERN

VERY LOW-LOSS LIQUID HELIUM TRANSFER WITH LONG FLEXIBLE CRYOGENIC LINES

CERN LEP-MA/89-38

by

H. Blessing, Ph. Lebrun, K. Schippl*

Table 1. Main characteristics of the corrugated stainless-steel tubes

Tube No.	Inner diameter (mm)	Outer diameter (mm)	Wall thickness (mm)	Material
1	10	13	0.3	AISI 304L
2	21	25	0.3	AISI 304L
3	39	44	0.4	AISI 304L
4	60	66	0.5	AISI 304L
sheath	66	73	3.5	Polymer

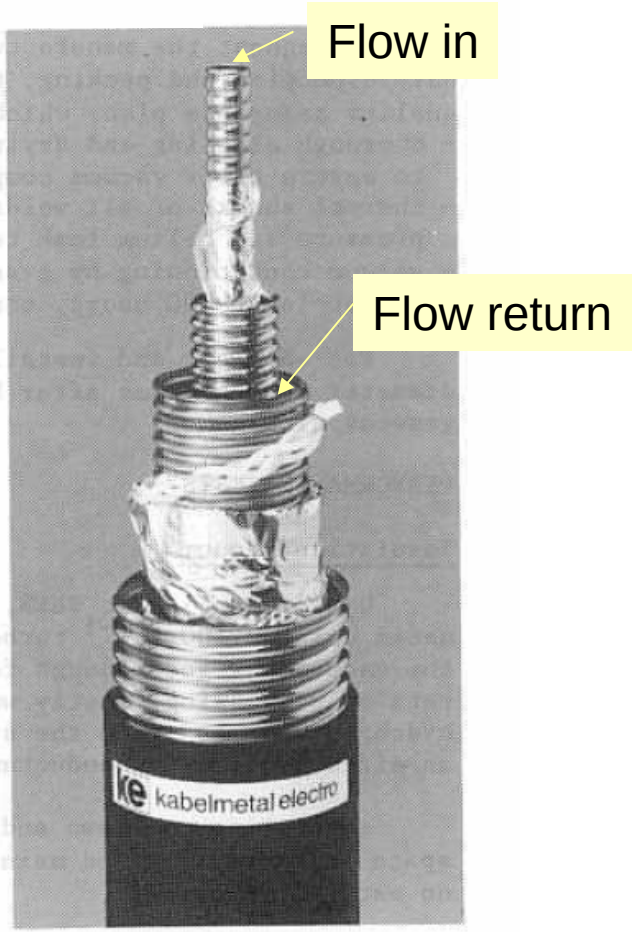
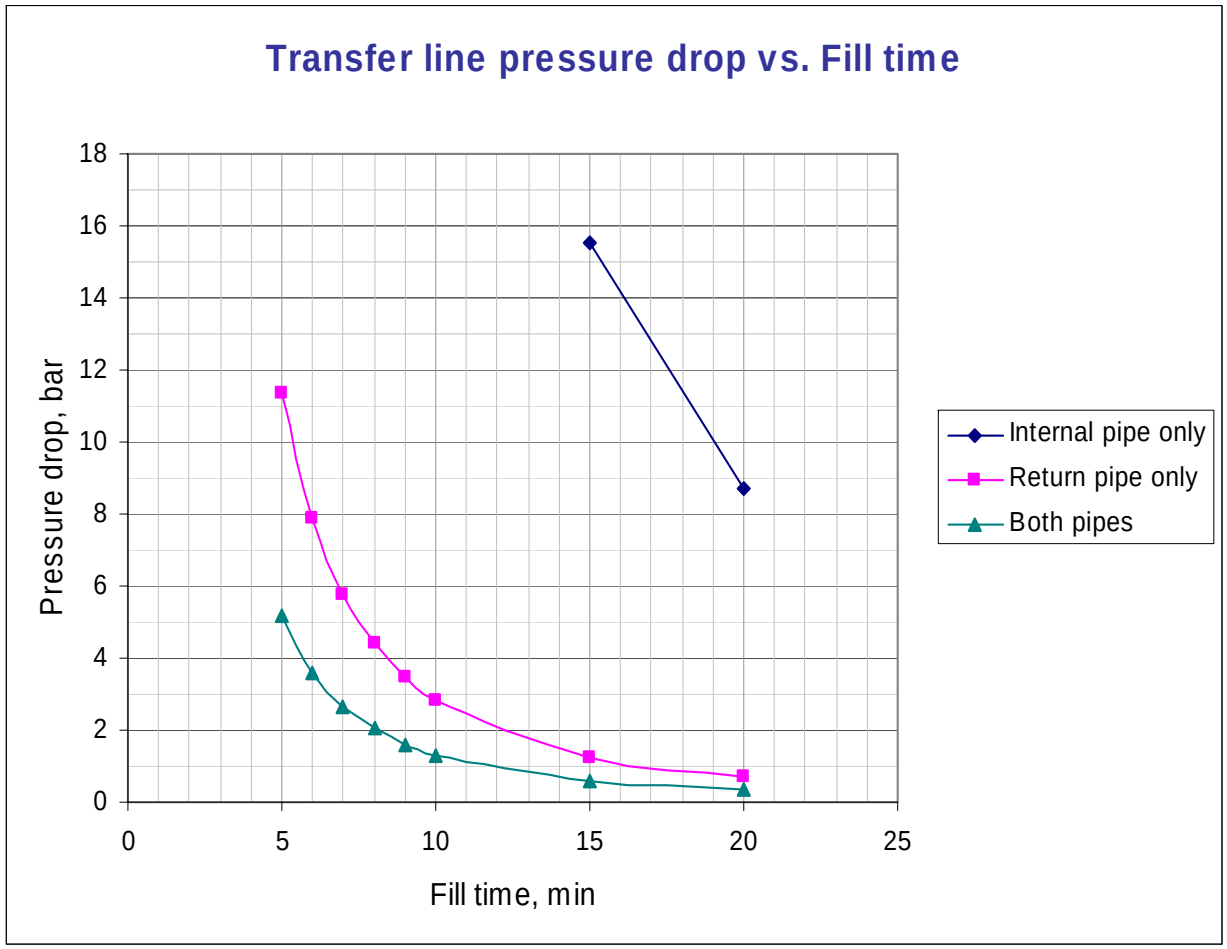


Fig. 1. Cross-section of a flexible transfer line showing the four corrugated stainless-steel pipes, helical braid spacers, metallized film insulation and external protective sheath.

CERN flexible transfer line as a fill line

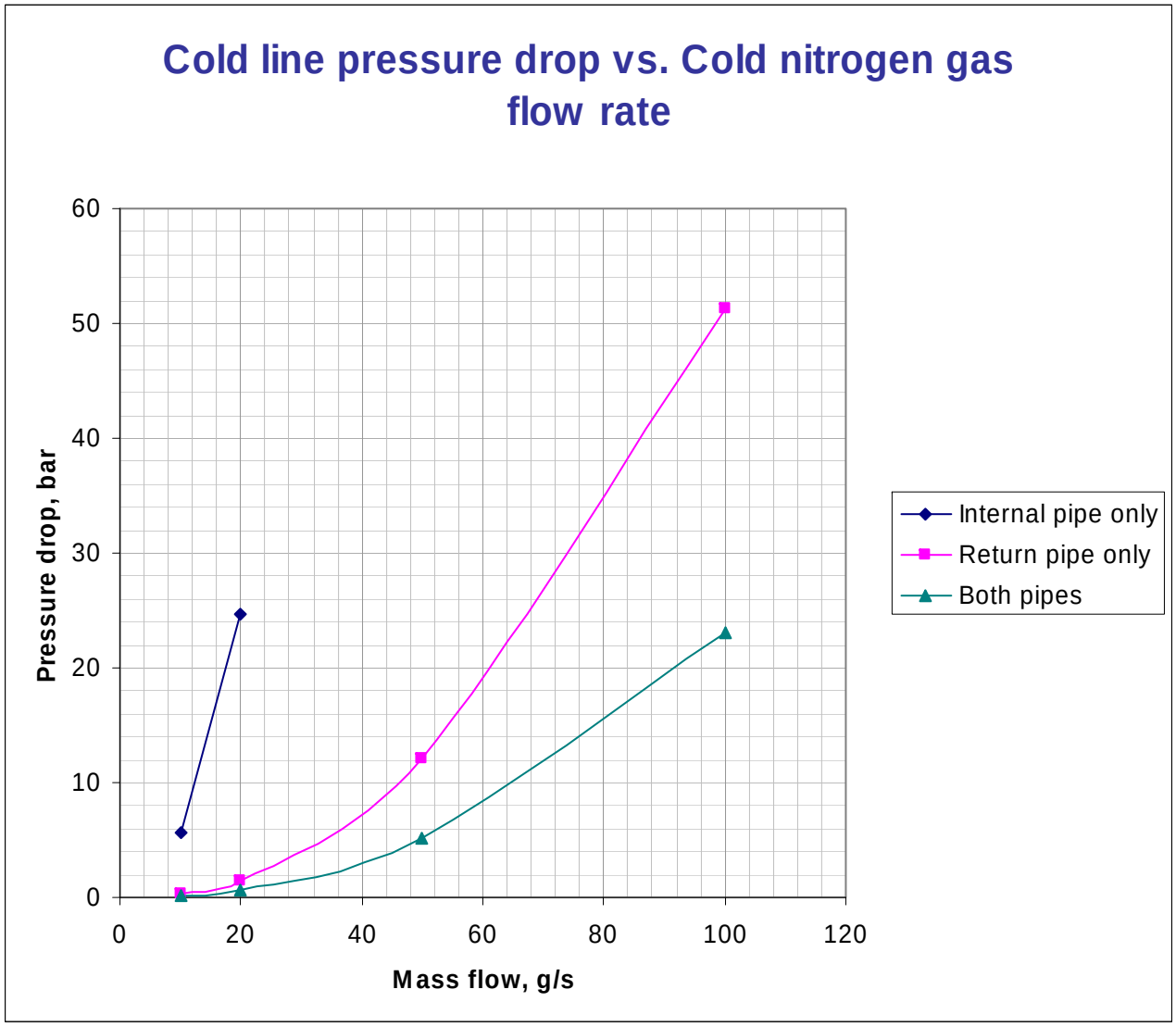


Fill volume =
300 l of LN

Geometry:
40 m of horizontal flexible transfer line with 4 bends

Conclusion: this line is OK as a fill line if both pipes are in use

CERN flexible transfer line as a cold vent line



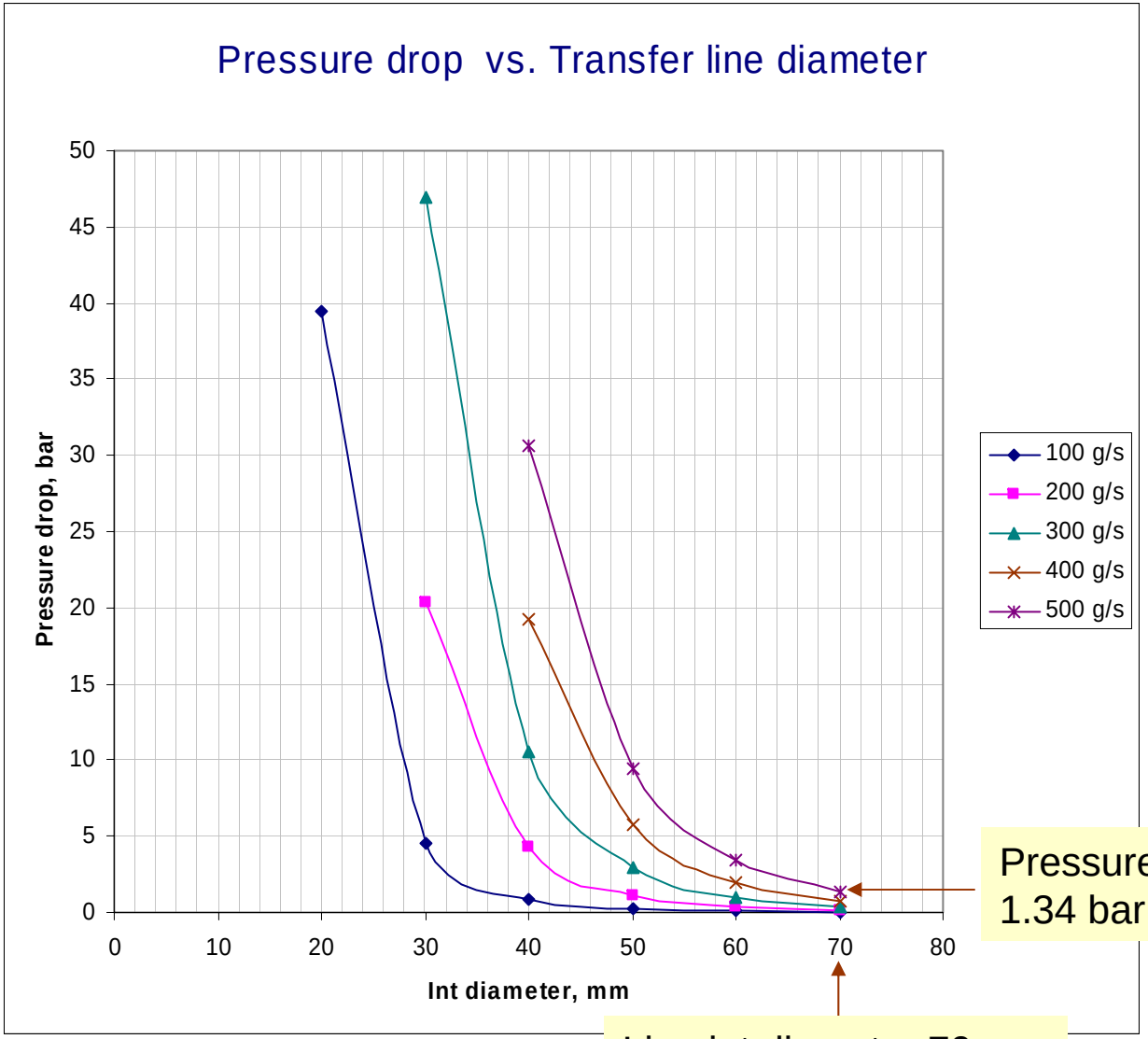
Geometry:
40 m of horizontal flexible transfer line with 4 bends

Note:
formula for compressible flow is used

Conclusion: this line can not be used as a cold line at high mass flow rate.

Cold vent line diameter calculation

Question: what is the optimal diameter for the cold vent line ?



Geometry:
40 m of horizontal flexible transfer line with 4 bends

Note:
formula for compressible flow is used

Pressure drop of 1.34 bar for 500 g/s

Line int diameter 70 mm

Cryogenic system cost estimate (Preliminary and not official !)

Item	Supplier	Cost	Quantity	Total cost, k£
Fill transfer line	AS Scientific, UK	£200 /m	40	8
Vent line	AS Scientific	£200 /m	40	8
Valves	Industry	£5000	7	35
Cold box	AS Scientific ?	£10000	1	10
Additional lines	AS Scientific	£100 /m	40	4
LN2 Dewar	CERN		1	2
Equipment installation	CERN + RAL	£200 / day	20	4
Instrumentation	Industry + MIT+ CERN + RAL			5
Control system	Industry + MIT + CERN + RAL			10
Total:				86
Contingency (30 %)				26
Total + Contingency				112

COST ESTIMATE (Draft)			
by F.Haug CERN-AT/ECR 13.April.2004			
TT2A Pulsed Magnet Installation and Operation		US	CERN*
	kCHF (material+manpower		
Proximity equipment			
1) DVB valve box	60	60	
2) vacuum pump for insulation vacuum of magnet/equipment			
3) vacuum pump for reducing pressure in bath	25		25
4) heat exchanger or el. heater	15		15
Intermediate Infra			
1) transfer line for cooling and filling	70		0
2) exhaust for cold nitrogen gas	70		0
3) pump line (warm) DN150	18		0
External Infra			
1) LN2 reservoir next to vertical shaft (rental)	20		
2) Concrete Platform (to be constructed)	20		20
Process control and instrumentation			
1) Controls equipmemnt (PLC/supervision) + programming	70	70	
2) Instrumentation and cabling	70	70	
Safety			
1) ODH and warning system	20		20
Installation			
Installation manpower	25		25
Deinstallation	10		10
Operation			
1) cryogenics team			
-surface tests 250 shots	20		20
-underground 250 shots	25		25
2) Fluids 200 l shot x 500 shots	15		15
TOTAL	553	200	175
Engineering			
ECR group engineering/design 4 man months = 80 days x1000 CHF/day	80		
GRAND TOTAL	633		
* if already available at CERN, material can be reused and results in lower costs			